CLAIMS

1. Apparatus for obtaining positional information relating to an object, comprising:

means for transmitting a probe signal towards the object, said transmitting means comprising a transmitting element;

means for receiving, at a plurality of spaced apart locations, the probe signal as returned by the object, said receiving means comprising a plurality of receiving elements forming an antenna array; and

detecting means, coupled to the receiving means, for detecting the relative timing of the returned probe signals as received at the plurality of spaced apart locations;

whereby the positional information for the object can be determined from said relative timing; and

wherein the transmitting element and receiving elements are disposed within a single housing or on a common substrate.

2. Apparatus according to Claim 1, adapted to be contained within a single housing.

3. Apparatus according to Claim 1, further comprising processing means and wherein the processing means and the antenna array are constructed as a single assembly.

4. Apparatus according to Claim 3, wherein the processing means operates to provide all functional electrical signals to and receive all functional electrical signals from the array.

5. Apparatus according to Claim 1, including at least three receiving elements arranged non-collinearly.

6. Apparatus according to Claim 5, wherein the at least three receiving elements are arranged such that there is no axis about which the array is symmetrical.

7. Apparatus according to Claim 1, including four receiving elements arranged non-collinearly.

8. Apparatus according to Claim 1, wherein the receiving elements are substantially the same.

9. Apparatus according to Claim 1, wherein the transmitting element and receiving elements have substantially the same field of view.

10. Apparatus according to Claim 1, wherein the spacing of two pairs of the receiving elements in a common direction is unequal.

11. Apparatus according to Claim 1, wherein the receiving elements are arranged substantially at the vertices of a trapezial locus.

12. Apparatus according to Claim 11, wherein the trapezial locus has long and short parallel sides, the length of the shorter side being approximately the wavelength λ of the radiation that the array is intended to transmit and receive, and the length of the longer side is approximately $3\lambda/2$.

13. Apparatus according to Claim 11, wherein the trapezial locus is rectangular.

14. Apparatus according to Claim 11, wherein the trapezial locus is non-rectangular.

15. Apparatus according to Claim 11, wherein the trapezial locus has long and short parallel sides and preferably the short side is between 0.5 and 1 times the length of the long side.

16. Apparatus according to Claim 1, wherein the receiving elements are arranged substantially at the vertices of a right-angled triangular locus.

17. Apparatus according to Claim 1, wherein the receiving elements are spaced apart by a distance that is the same order of magnitude as the wavelength λ of the radiation that it is intended to transmit and receive.

18. Apparatus according to Claim 17, wherein the receiving elements are spaced apart by a distance $m\lambda$ where m is less than 10, and preferably less than 2, and m is greater than 0.3.

19. Apparatus according to Claim 1, further comprising a processing stage operable to detect the interval between a signal being received by a first set of any two or more of the receiving elements and to determine a first angular position of an object from which the transmitted signal has been reflected; and to determine the interval between a signal being received by a second set of any two or more of the receiving elements and to determine a second angular position of an object from which the transmitted signal has been reflected.

20. Apparatus for obtaining positional information relating to an object, comprising a processing stage operable to detect the interval between a signal being received by a first set of any two or more of the receiving elements and to determine a first angular position of an object from which the transmitted signal has been reflected; and to determine the interval between a signal being received by a second set of any two or more of the receiving elements and to determine a second angular position of an object from which the transmitted signal has been reflected.

21. Apparatus according to Claim 1, wherein the detecting means comprises switched sampling stages triggered from a common signal distributed via delay lines.

22. Apparatus according to Claim 1, wherein the frequency of the transmitted signal is between 0.5 and 77 GHz, and preferably is between 2 and 25 GHz.

23. Apparatus according to Claim 22, wherein the frequency of the transmitted signal is one of approximately 0.5GHz, 1GHz, 6 GHz, 10 Ghz, and 2 to 2.5 GHz.

24. Apparatus according to Claim 22, wherein the frequency of the transmitted signal is 2.45 Ghz.

25. Apparatus according to Claim 1, further comprising means for applying a cross-correlation process to the returned probe signals.

26. Apparatus according to Claim 25, wherein the cross-correlation process is a truncated cross-correlation process.

27. Apparatus according to Claim 25, wherein the cross-correlation process is applied after a sampling process.

28. Apparatus according to Claim 1, being operative in an operating cycle for each of **m** steps in which **n** = 1, 2 .. **m**, and including:

a signal generating stage operative, simultaneously with or at a fixed time after a transmitting trigger instant t_n to generate a signal, and a transmitting element to transmit said signal into a detection field;

a plurality of spaced receiving elements operative simultaneously with or at a fixed time after a receiving trigger instant r_n to receive a portion of the signal reflected from one or more objects in the detection field, the interval $r_n - t_n$ varying as a function of **n** and having a magnitude in a range corresponding to the times of travel of a signal reflected from an object within the detection field;

means for identifying the values of **n** at which signals reflected from one object are received at two or more receiving elements and thereby detecting the time taken, and therefore the distance travelled, by the signals from the transmitting element to the various receiving elements; and

means for calculating the position of the object from the various path lengths thereby identified.

29. Apparatus for obtaining positional information relating to an object, operative in an operating cycle for each of **m** steps in which **n** = 1, 2 .. **m**, and including:

a signal generating stage operative, simultaneously with or at a fixed time after a transmitting trigger instant t_n to generate a signal, and a transmitting element to transmit said signal into a detection field;

a plurality of spaced receiving elements operative simultaneously with or at a fixed time after a receiving trigger instant r_n to receive a portion of the signal reflected from one or more objects in the detection field, the interval $r_n - t_n$ varying as a function of **n** and having a magnitude in a range corresponding to the times of travel of a signal reflected from an object within the detection field;

means for identifying the values of **n** at which signals reflected from one object are received at two or more receiving elements and thereby detecting the time taken, and therefore the distance travelled, by the signals from the transmitting element to the various receiving elements; and

means for calculating the position of the object from the various path lengths thereby identified.

30. Apparatus according to Claim 1, wherein the positional information includes at least one of the range, azimuth and elevation of the object.

31. Apparatus according to Claim 1, further comprising:

a warning zone definition stage for defining a warning zone within a detection field of the apparatus; and

a discrimination stage for determining whether a detected object is within the warning zone;

in which the warning zone is defined as a three-dimensional region within the detection field,

wherein the warning zone is contained within and is smaller than the detection field of the apparatus.

32. Apparatus for obtaining positional information relating to an object, comprising:

a warning zone definition stage for defining a warning zone within a detection field of the apparatus; and

a discrimination stage for determining whether a detected object is within the warning zone;

in which the warning zone is defined as a three-dimensional region within the detection field,

wherein the warning zone is contained within and is smaller than the detection field of the apparatus.

33. Apparatus according to Claim 31, wherein the shape of the warning zone is dissimilar from the shape of the detection field of the apparatus.

34. Apparatus according to Claim 31, wherein the warning zone definition stage is adapted to define a warning zone as a function of a coordinate within the detection field.

35. Apparatus according to Claim 31, further comprising an object location stage for determining the position of a detected object within the detection field of the apparatus.

36. Apparatus according to Claim 31, wherein the discrimination stage is adapted to determine the coordinates of the detected object and to compare the determined coordinates with the coordinates of the warning zone to determine whether the object is within the warning zone.

37. Apparatus according to Claim 31, wherein the warning zone definition stage is adapted to define a plurality of non-coextensive warning zones, and preferably wherein the discrimination stage is adapted to generate an output signal indicative of which of the plurality of warning zones contains the object.

38. Apparatus according to Claim 37, wherein the discrimination stage is adapted to apply different logic to at least two of the zones.

39. Apparatus according to Claim 31, wherein the warning zone is approximately cuboid.

40. Apparatus according to Claim 31, wherein the discrimination stage is adapted to analyse a characteristic of an object outside of the warning zone.

41. Apparatus according to Claim 40, wherein the discrimination stage is operable to track an object outside the warning zone and to predict its entry into the warning zone.

42. Apparatus according to Claim 31, wherein the warning zone definition stage is adapted to determine the shape and a relevant dimension of the warning zone at least in part by a corresponding shape and dimension of a vehicle associated with the apparatus.

43. Apparatus according to Claim 31, wherein the warning zone definition stage is adapted to determine the shape and a relevant dimension of the warning zone in dependence on operating conditions of a vehicle associated with the apparatus.

44. Apparatus according to Claim 43, wherein the vehicle operating conditions include at least one of speed, direction of travel, and ambient environmental conditions.

45. Apparatus according to Claim 31, wherein the warning zone definition stage is adapted to define a detection field within a passenger compartment of a vehicle associable with the apparatus.

46. Apparatus according to Claim 31, further comprising a display adapted to present a visual representation of a detection field of the apparatus and an object within the detection field.

47. Apparatus according to Claim 1 for use in a vehicle.

48. Apparatus according to Claim 47, wherein the antenna array is adapted to be located on a fixed location on the vehicle.

49. Apparatus according to Claim 47, wherein the antenna array is adapted to be located within a component of the vehicle, and preferably within a non-metallic component.

50. Apparatus according to Claim 47, wherein the antenna array is adapted to be located within a bumper of the vehicle, and preferably within a non-metallic bumper.

51. Apparatus according to Claim 1, further comprising means for obtaining information about objects within or behind a wall.

52. Apparatus according to Claim 1, further comprising means for providing an image of an environment in conditions that human vision is compromised.

53. Apparatus according to Claim 52, operable when vision is compromised by the physiological condition of a user.

54. Apparatus according to Claim 52, operable when vision is compromised by environmental conditions.

55. A vehicle comprising:

means for transmitting a probe signal towards the object, said transmitting means comprising a transmitting element;

means for receiving, at a plurality of spaced apart locations, the probe signal as returned by the object, said receiving means comprising a plurality of receiving elements forming an antenna array; and

detecting means, coupled to the receiving means, for detecting the relative timing of the returned probe signals as received at the plurality of spaced apart locations;

whereby the positional information for the object can be determined from said relative timing; and

wherein the transmitting element and receiving elements are disposed within a single housing or on a common substrate.

56. A hand-held tool comprising:

means for transmitting a probe signal towards the object, said transmitting means comprising a transmitting element;

means for receiving, at a plurality of spaced apart locations, the probe signal as returned by the object, said receiving means comprising a plurality of receiving elements forming an antenna array; and

detecting means, coupled to the receiving means, for detecting the relative timing of the returned probe signals as received at the plurality of spaced apart locations;

whereby the positional information for the object can be determined from said relative timing; and

wherein the transmitting element and receiving elements are disposed within a single housing or on a common substrate.